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*The Endless Forms Customizable Card Game*

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CATALOGUE  
*of*  
SPECIES

and

*Notable  
Phenomena*



*Endless  
Forms*

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*Asombro Institute for Science Education Edition*

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# About

This journal is a companion to the Asombro Edition starter deck of the game *Endless Forms*. Here you'll find background information on every one of the 50 cards in this ready-to-play deck. This edition features the incredible flora & fauna of the Chihuahuan Desert.

*Endless Forms* is a 2-player strategy card game based on real organisms and natural science concepts. The abilities of the Species cards in the game reflect the real-life survival strategies of the animals the cards are named after. Likewise, the consequences of Effect and Event cards mirror the effects of the natural phenomena that they are based upon.

By playing the game, we hope that players will intuitively learn the roles that these wild organisms, habitats, and biological concepts play in nature. The reverse is also true: by reading this guide which provides the factual background of each card, we hope that players will better appreciate how these cards function in the game.



To learn more about *Endless Forms*  
and to find out where to buy cards,  
follow @EndlessFormsGame  
on Facebook or Instagram,  
or email [EndlessFormsGame@gmail.com](mailto:EndlessFormsGame@gmail.com)

"It is interesting to contemplate an entangled bank, clothed with many plants of many kinds, with birds singing on the bushes, with various insects flitting about, and with worms crawling through the damp earth, and to reflect that these elaborately constructed forms... have all been produced by laws acting around us...

There is grandeur in this view of life, with its several powers, having been originally breathed into a few forms or into one; and that, whilst this planet has gone cycling on according to the fixed law of gravity, from so simple a beginning endless forms most beautiful and most wonderful have been, and are being, evolved."

The quote above, which forms the final passage of *On the Origin of Species* by Charles Darwin, is the inspiration for the name "*Endless Forms*". The branching image on the front of this booklet is a drawing from Darwin's notebook, sketched as he imagined how related species descending from a common ancestor would make up a great "tree of life".

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## *note on the Asombro Institute edition*

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All proceeds from the sale of the first edition of *Endless Forms* benefit the *Asombro Institute for Science Education*, a non-profit which has dedicated itself to improving natural science literacy in Las Cruces, NM for more than 30 years.

The Asombro Institute serves more than 22,000 K-12 students and 1,500 adults in New Mexico each year with hands-on, inquiry-based science education programs. These programs take place in classrooms, schoolyards, and at Asombro's outdoor classroom, the Chihuahuan Desert Nature Park, north of Las Cruces. The nature park is free to visit and open to the public year-round.

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*To learn how else you can help,  
visit [www.asombro.org](http://www.asombro.org)*

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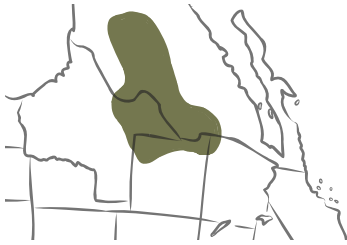
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# Introduction

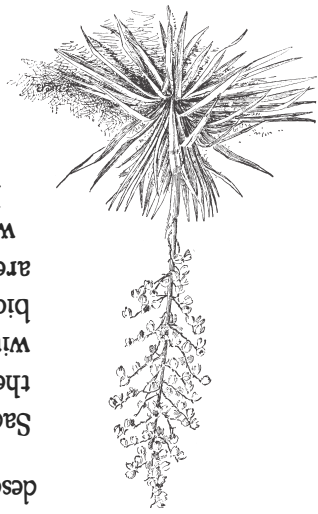
The *Chihuahuan Desert* is North America's largest desert, covering an area of around 250,000 square miles. It is regarded as the most diverse desert in all of the

Western Hemisphere, home to over 1,000 unique plant species including a quarter of the world's cactus species. There are many reptiles, amphibians, and even fish that can only be found in this region.



The Chihuahuan Desert receives just 6 to 20 inches of rain each year, most of which falls during the summer monsoon thunderstorms. This sets it apart from the Mojave and Sonoran deserts, as does its cold winters. High mesas and forested mountain ranges alternate with flat shrubland basins where playas, salt lakes, and sand dunes may be found. Yucca, sotol, agave, cactus, ocotillo, creosote, and mesquite are commonly encountered, as are the Greater Roadrunner, Javelina, Western Diamond-backed Rattlesnake, and Texas Horned Lizard. All must contend with the arid conditions found in this desert, and do so in remarkable ways.

Sadly, the Chihuahuan Desert is also one of the most endangered ecoregions in the world, with human activities threatening its rich biodiversity in myriad ways. By studying this area and the incredible organisms within it, we can better understand how to protect its future flourishing as well as our own.



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**Desert Playa:** After a summer monsoon rain, water collects in flat desert basins to form short-lived pools called playas. An entire ecosystem springs up during the few weeks that the water remains. Crustacean eggs laid in the playa the previous year hatch when the water returns. Seeds sprout, toads emerge from underground burrows nearby, and snakes and birds arrive to drink and feed at this temporary oasis.

**Gypsum Flats:** While sand dunes are not uncommon in the flat closed basins of the Chihuahuan Desert, White Sands National Park in New Mexico is unique in the world as the largest gypsum dune field of its kind. Formed only about 7000 years ago, a unique community of plants and animals has since adapted to this new environment, including “blanched” species with light coloration to match the pure white terrain.

**Lava Malpais:** Just around 30 miles north of White Sands, New Mexico is another recently-formed landscape. This lava field, with its pitch black volcanic rock, could perhaps not be more different than the soft white dunes found to the south. However, it too has been the site of adaptation by wild organisms, with “melanic” species of darker complexion finding success among the black boulders.

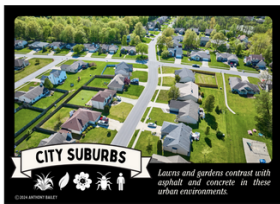
**Ocotillo FootHills:** Often found on rocky hillside slopes, the spiny ocotillo is well-adapted to dry desert environments. Its red flowers, a favorite of hummingbirds, appear at the tip of each of its arms in the spring. Small deciduous leaves grow in response to rain, and then fall during periods of dry weather in order to reduce water loss. When leafless, photosynthesis takes place in the stems.

**River Bosque:** Desert rivers like the Rio Grande form corridors of lush vegetation that cut through the otherwise arid landscape, providing important habitats and resources for aquatic animals and migrating birds. The cottonwood trees and willows that the river supports make up what is known as the “bosque” (“forest” in Spanish). These special ecosystems have been significantly diminished by human activities.

# Habitats



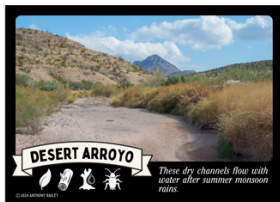
**Agricultural Land:** People have learned ways to grow many different kinds of crops over very large areas, even in regions that receive little rainfall. These swaths of land can provide resources to local wildlife that they would not naturally have access to, but this comes at a price - crop land replaces native habitats, and the pesticides used can harm native organisms and environments.



**City Suburbs:** Humans bring many plants, whether for food or decoration, along with them when they settle in a new place. In this way, the green parts of towns and cities can feature a wide array of both native and non-native plants, creating a diverse artificial habitat for other organisms. In some cases, however, introduced species spread and harm native ones.



**Creosote Scrub:** The creosote bush, also known as rainbush, is one of the most dominant plants in the Chihuahuan Desert. Its small leaves help reduce water loss and are responsible for the fresh and fragrant smell of the air after rainfall in this region. Pictured on this card is an expanse of typical creosote shrubland near Las Cruces, NM, with the Organ Mountains visible in the background.



**Desert Arroyo:** With little topsoil, sparse vegetation, and rain that comes in short, intense bursts, water tends to flow swiftly across desert landscapes, rather than soaking into them. The low, sandy channels where water tends to flow during and after a thunderstorm are known as arroyos. Along the banks of arroyos, you'll find a community of plant life not seen in adjacent areas.



**Desert Grassland:** Grasslands in the Chihuahuan Desert are home to many unique species and are an important wintering ground for migratory birds. However, due in part to overgrazing and climate change, they are an increasingly rare sight in this region. Protection and further study of these habitats will be critical if they are not to disappear altogether.

# Species



**American Badger (*Taxidea taxus*):** North America's only badger, this carnivore is common throughout the western and central U.S. as well as Mexico. Its powerful arms and long claws are specialized for digging prey like small mammals & reptiles out of their underground shelters. Abandoned badger burrows and excavations provide important living spaces for many other animals, such as burrowing owls. Interestingly, badgers and coyotes have often been observed hunting in tandem. Coyotes may lead badgers to prey that they have chased into a burrow, which the badger can then dig up.



**American Kestrel (*Falco sparverius*):** The smallest falcon in North America, these birds are often seen perched on power lines or telephone poles, searching the ground below for prey. They can also do this while in mid-air, constantly flapping to hover above the ground while keeping their head and eyes steady. Males have slate gray wings and rusty red backs. Both sexes have black vertical stripes or "sideburns" on their light-colored heads. These birds have a varied diet and live in a range of habitats. They are common year-round in the Chihuahuan Desert.



**Banner-tailed Kangaroo Rat (*Dipodomys spectabilis*):** Neither rats nor kangaroos, these nocturnal rodents do not scurry but rather hop to move from place to place, the white tips of their tails waving as they do so. They forage primarily for seeds which they carry in pouches in their cheeks. They cache (or store) large numbers of these seeds in their burrows, which are noticeable as mounds on the surface. These large kangaroo rats defend their territory from others of their kind by standing on top of their mounds and drumming their feet on the ground.



**Black-chinned Hummingbird (*Archilochus alexandri*):** Widespread in the western U.S. and Mexico, males have a dark head with a strip of iridescent feathers on their throats that shines purple in the sunlight. At rest, their hearts beat around 500 times a minute. When feeding on flower nectar, they perform about 15 licks per second, and in the winter can consume three times their body weight in a single day. If nectar is not available, they can survive by eating insects. Though small, these birds can travel over 1,000 miles during their migration to Mexico each fall.





Black-throated Sparrow (*Amphispiza bilineata*): If you find yourself in a seemingly lifeless stretch of desert scrub, listen for the metallic, tinkling calls of these striking little sparrows. Distinguished by two bold white stripes on their heads, these are often the only birds you'll encounter in many of the hottest, driest areas of the Chihuahuan Desert. Groups stay near the ground, calling to one another as they hop from bush to bush in search of insects.



Creosote Bush Walkingstick (*Dipsacromera corvillae*): This insect is one of the few animals that eats the leaves of the creosote bush, a plant which it blends in superbly. As juveniles, their bodies are a bright green, matching the creosote's fresh leafy stems. They then mature to a dull brown or orange, just like the shrub's older branches. In addition to looking like a stick, they also try to behave like one, walking with a swaying side-to-side motion in order to appear like a windblown stem. A male (orange) and a female (larger and gray) can be seen in the photo on this card.



Coyote (*Canis latrans*): Intelligent and opportunistic, these canines have keen senses and are mostly nocturnal. Pairs often remain mates for many years, raising young together, and family groups may stay together in packs. The yaps and howls heard in the desert at night are often a pack's way of maintaining its territory. The Coyote has a special relationship with the American Badger: both are often observed hunting together. Coyotes may lead badgers to prey that they have chased into a burrow, which the badger can then dig up. This arrangement appears to benefit them both.



Chihuahuan Raven (*Corvus cryptoleucus*): Like the American Crow and Common Raven, the Chihuahuan Raven is intelligent and social, but it is better than both at surviving in dry environments. These omnivores are not picky eaters, foraging for a variety of plants, insects, and occasionally live vertebrates. Pairs perform lively, acrobatic flights together and often remain mated for life. This species is found in southern Arizona, New Mexico, Texas, and a large portion of Mexico. The oldest recorded wild Chihuahuan Raven was 21 years old.



Rites of Spring: The arrival of spring brings with it a flurry of activity and color. As the days get longer, plants receive more sunlight and thus more energy to produce stalks, leaves, and buds. As temperatures rise and moisture increases, seeds germinate and sprout. Insects hatch or emerge from dormancy and buzz about in search of food. All this means a wealth of resources for herbivores and insectivores, many of which use this time of plenty to begin reproducing and raising offspring.



Wildfire: Wildfires have burned on our planet for over 400 million years. They were first made possible when enough plants had moved from the ocean onto land and enough oxygen was present in the atmosphere to sustain a spark from a lightning strike. While they may seem destructive, wildfires can actually benefit a healthy ecosystem, and many plants can survive fire to germinate. Some animals also rely on fire, like the Fire Chaser Beetle, which must lay its eggs in freshly burned wood. The size and intensity of many wildfires has been made more extreme by drought, higher average temperatures, and excess fuel due to past fire suppression.



**Hyper-adaptive Fauna:** Several groups in the animal kingdom are recognized as having a human-like capacity to learn and solve novel problems. This includes crows like the one on this card, seen holding a stick in its beak. New Caledonian Crows select and carefully shape sticks like these in order to fish grubs out of their burrows. In addition to tool use, crows are known for their clever resourcefulness, memory, social structure, and playfulness. This cognitive flexibility can help them survive and adapt to new situations and environments.



**Limited Resources:** Many human activities affect the environments we share with wild organisms. Dams are built along rivers to control the flow and supply of water for human use, such as irrigation. The Elephant Butte Dam along the Rio Grande River in New Mexico, pictured on this card, generates electricity and helps ensure that farmers have the water they need to grow crops. However, this and other changes to the river system have significantly reduced wetland habitats, disrupted the movement of fish, and left entire stretches of the river dry through much of the year.



**Offroading Degradation:** While many people use ATVs and other vehicles to access and enjoy remote areas, concerns arise when the adventure goes off-trail. In desert regions there is very little topsoil. This important layer is often protected by a thin upper crust. A variety of organisms, such as fungi, lichens, and mosses, inhabit this layer and help hold sand grains in place. When this “biocrust” is damaged by wheels or shoes, rainwater washes into the topsoil rather than over it, carrying soil and nutrients away from the area. Increased erosion, as well as damage to plants and destruction of burrows, are great reasons to stay on established roads and trails in order to protect the places we love to visit.



**Once Thought Extinct:** An untold number of species who have survived on this planet for millions of years have been erased due to recent human activity. In rare cases, organisms that we thought were extinct have been rediscovered, such as the Coelacanth pictured on this card. This group was only known from fossils until 1938 when a live individual was caught in the Indian Ocean. Giant, nocturnal, and long-lived, Coelacanths have limb-like fins and are our closest fish relatives. Such cases illustrate humanity’s unprecedented impact on the biosphere, as well as the tenacity of living creatures.



**Gray Vireo** (*Vireo vicinior*): Another tough resident of some of the hottest regions in the southwest, the songs of these small gray passerines are heard throughout the spring. They forage for insects in bushes and trees as well as on the ground, and are known for flicking their tails as they move about. While the female builds a functional nest, the male sometimes builds a more primitive one nearby. These “bachelor nests” are not used but may function as decoys, or simply form part of the pair bonding process. The Gray Vireo is a Species of Greatest Conservation Need in New Mexico.



**Greater Earless Lizard** (*Crotaphytus wislizeni*): These heat-loving lizards are a common sight in the Chihuahuan Desert, even during hot summer days. They are often seen perched on rocks keeping watch over their territory and looking for insect prey. Their black-banded tails curl high over their bodies when they run, helping them to scurry even faster and providing a distraction to any pursuers. While the name suggests otherwise, earless lizards do in fact have ears - their external openings are simply covered with scales to keep them free of dirt.



**Greater Roadrunner** (*Geococcyx californianus*): An iconic resident of the American southwest, the roadrunner is not only fast but fierce. These birds are capable of killing and eating rattlesnakes, scorpions, and even the horned lizard, which they consume head-first so as not to be harmed by its bony spikes. While capable of flying, they prefer to run, leaving distinctive X-shaped footprints behind. These expressive birds use their feathers, colors, and wide range of vocalizations to defend their territory and court a mate, which they will keep for their entire lives.



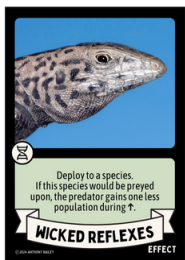
**Melon Aphids** (*Aphis gossypii*): Also known as the cotton aphid, this insect is found across much of the world. It feeds on a large number of plants in addition to melons and cotton. Like all aphids, it drinks sap from leaves and stems through its sharp, straw-like mouth. Aphids drink so much sap that the waste they produce, called honeydew, still contains valuable sugars and nutrients which other animals can make use of. For this reason, many species of ants have mutually beneficial relationships with aphids, protecting them from predators in exchange for a steady supply of food.







**Stable Climate:** Earth experiences natural climate cycles, or changes in large-scale weather patterns. Some of these cycles happen over tens of thousands of years and are linked to Earth's orbit around the Sun, and others occur over just a few years such as El Niño and La Niña. However, rapid changes in climate, such as those caused by meteor impacts, volcanic eruptions, or the unprecedented increase of atmospheric carbon dioxide due to human activities, can lead to widespread extinctions as organisms struggle to adapt. While a stable climate allows many organisms to flourish, biodiversity is life's safeguard against such dramatic shifts.



**Wicked Reflexes:** For many animals, a quick escape can be the best way to avoid danger. Involuntary reflexes are an adaptation that help animals react to a threat almost instantaneously. These nervous signals often do not travel to the brain, allowing the creature to react more quickly without conscious thought. Some of the quickest reflex times known in the animal kingdom are seen in insects, whose small size means that nervous signals can travel across their bodies more rapidly.



**Roundtail Horned Lizard (*Phrynosoma modestum*):** This small horned lizard, or “horny toad”, is particularly well-camouflaged for desert environs. In addition to the earthy colors of its scales, this lizard rounds its back and closes its eyes to appear like a rock. Like other horned lizards, it specializes in eating ants. A summer walk in the desert is likely to put you in the path of a horned lizard, but if they don’t move, you’ll be hard-pressed to spot them!



**True Cochineal Bug (*Dactylopius coccus*):** There is a long and fascinating story behind the white “fuzz” often seen on prickly pear cacti. Underneath are tiny red bugs related to aphids and other scale insects. These bugs feed on cactus sap and produce the white material to protect themselves from the sun. Females are wingless and live their entire lives in the same spot. Native peoples in Mexico developed a process to collect, dry, and crush cochineal in order to make a vibrant red dye known as carmine. This pigment was coveted by Europeans, whose used it to dye the scarlet uniforms of Catholic cardinals as well as the famous British “redcoats.”



**Turkey Vulture (*Cathartes aura*):** Turkey Vultures live across the U.S. and perform an essential service. By using their keen senses of smell and sight, they locate and clean up carcasses that would otherwise sit, accumulate, and spread disease. Between their association with death, and their bare faces (which help them stay clean), these buzzards often get a bad rap. In reality, they should be appreciated for helping to keep our ecosystems clean and healthy.



**Western Hognose Snake (*Heterodon nasicus*):** The Western or Plains Hognose Snake is found across the central U.S. Their distinctive “nose” is a modified scale which helps them dig in loose soil as they look for shelter and food. These snakes specialize in hunting toads, and have a natural resistance to the toxins found in their skin. Hognose snakes are famous for their dramatic acting. If threatened, they may flatten their heads, puff their bodies, hiss, and pretend to strike. They are also known to play dead by flipping upside down with their mouths hanging open, and soiling themselves for added effect.

# Effects

**Aesthetic Choice:** Eyesight is often essential for survival, and as a result many animals are visually-oriented. Natural selection has shaped the physical traits and behaviors of some of these organisms to maximize their visual appearance, often in service of attracting a mate. The males of some species (like peacocks, birds of paradise, and peacock spiders) become the physical embodiment of the aesthetic “tastes” of the females of their own kind. Males use flashy colors, iridescent structures, and body movements to create the specific optical illusions and effects that seem to appeal to their choosy counterparts.



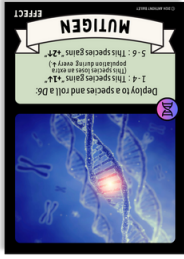
**Artificially Sustained:** Humans support large populations of domestic animals by providing them with resources like food and water. When these animals are allowed to roam free outdoors, they can do serious damage to local populations of wildlife who lack such artificial advantages. For example, even if they are well-fed at home, domestic cats will still hunt if allowed outside. Cats have contributed to the extinction of dozens of species of birds, reptiles, and mammals, and it is estimated that they kill over 2 billion birds in the U.S. every single year.



**Environmental Homogenization:** Human activities often convert diverse natural areas into a single type of environment, such as when the varied land in a river valley is transformed into farmland. This lack of diversity poses problems for both wildlife and humans - fewer resources for wildlife, and higher risk of disease wiping out entire crops for humans.



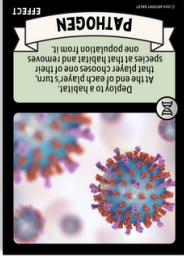
**Insect Swarm:** The right combination of conditions can sometimes cause the population of an insect species to rapidly increase, aided in part by the large numbers of eggs they produce. High population densities can then trigger a swarm to begin moving across the land in search of more space and resources. Other swarm behavior is seen when insects prepare to reproduce. For example, ant and termite colonies produce winged kings and queens at special times of the year. They wait to leave the nest until particular weather conditions arrive, and then leave *en masse* on mating flights.



**Mutigen:** Mutations, or uncontrolled changes to the DNA code, have played an important role in the evolution of life on this planet. Caused by damage from high-energy light or particle radiation, or by copy errors when DNA is being duplicated in the cell, random mutations are often harmful and so organisms have many protections against them. However, in rare cases a mutation can cause a new trait to emerge in an organism that actually benefits its survival. Having a small but not too small mutation rate has helped increase the diversity, and thus the survival, of life on Earth.



**Pack Hunt:** Some predators work cooperatively with others of their species, usually close family members, to hunt for prey. A variety of animals behave in this way, from mammals like wolves, dolphins, and monogoses, to birds like the Harris's Hawk, reptiles like the crocodile, and even some arthropod species like army ants and velvet spiders.



**Pathogen:** Microbes are found in nearly every environment on Earth, including the outside and inside of other living organisms. Their presence is usually harmless or often benefits the creatures they live alongside. Some, however, cause disease in other organisms. Disease-causing viruses, bacteria, and multi-cellular eukaryotes have shaped the history and evolution of life on this planet, including the human species, as organisms must adapt to keep up with the ever evolving survival strategies of these invisible organisms.



**r-Strategist:** Different species employ different methods of reproduction. K-strategists (such as humans and elephants) are large, long-lived animals that invest a great deal of time and effort into the few offspring they produce. Because of this investment, these offspring have a relatively high chance of survival. In contrast, r-strategists (such as frogs and insects) are smaller, live much shorter lives, and produce very large numbers of offspring which they protect very little or not at all. Even though any one offspring has a very small chance of survival, there are so many of them that a few are bound to make it to adulthood. Both strategies work to ensure the species' survival.